

Winter 2021



Detroit Solar Toolkit

Solar 101





Our Team

THIS TOOLKIT IS SUPPORTED BY A TEAM LEAD BY ELEVATE ENERGY WITH PARTNERS DETROIT COLLABORATIVE DESIGN CENTER, DATA DRIVEN DETROIT, ECOWORKS, GREAT LAKES ENVIRONMENTAL LAW CENTER, MICHIGAN ENERGY OPTIONS, AND THE NATIONAL RENEWABLES ENERGY LABORATORY.

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Contents

Energy Efficiency Preparation for Solar	3
Energy Smart	3
Weatherization Assistance Programs	3
Financing Energy Efficiency Upgrades and Solar	4
Solar 101	6
The Basics	6
Safe Solar	6
Low-Risk Solar PV	6
PVC System Category Types	7
Category 1	7
Category 2	7
Solar Permitting Process	8
Solar Permitting Process	8
Solar in Historic Districts	8
DTE Online Application	8
City of Detroit Solar Permitting	9
Current Net Metering for Solar	9
Distributed Generation Details	9
Consumer Protection	12
PV Industry Standard Warranties	12
Fraudulent Solar Claims (False Marketing and Sales Tactics)	13
Filing Consumer Complaints	13
Local Assistance	13
Solar FAQs	14
Solar Glossary	15

Figures	3
Figure 1: EcoWorks Energy Smart diagram for understanding home energy use, interactions, and the utility bill	4
interactions, and the utility bill	6
Figure 2: Options for financing different types of solar	7
Figure 3: Basic Solar Layout	12
Figure 4: Current Distributed Generation (Net Metering) “retail credit” program in Michigan	
Figure 5: The seven spheres of energy regulation that the MPSC can shape for Michigan utility customers	

Energy Efficiency Preparation for Solar

A key aspect of a solar-ready home is ensuring that your home is first an energy efficient home, with consumption that is below average for the size and number of occupants for your residence. This helps avoid high energy use power supply charges for daily average use greater than 17 kWh.

Energy efficiency is the foundation of any home or commercial structure that has solar PV as part of the building structure. There are free programs offered through DTE, such as Energy Consultation and Energy Efficiency Assistance (EEA), which allow residents to receive free energy efficient services or materials for households. In addition, for those households that are not low- to moderate-income, rebates are available when purchasing qualifying new energy efficient appliances and lighting as well as heating, ventilation, and air conditioning (HVAC) systems.

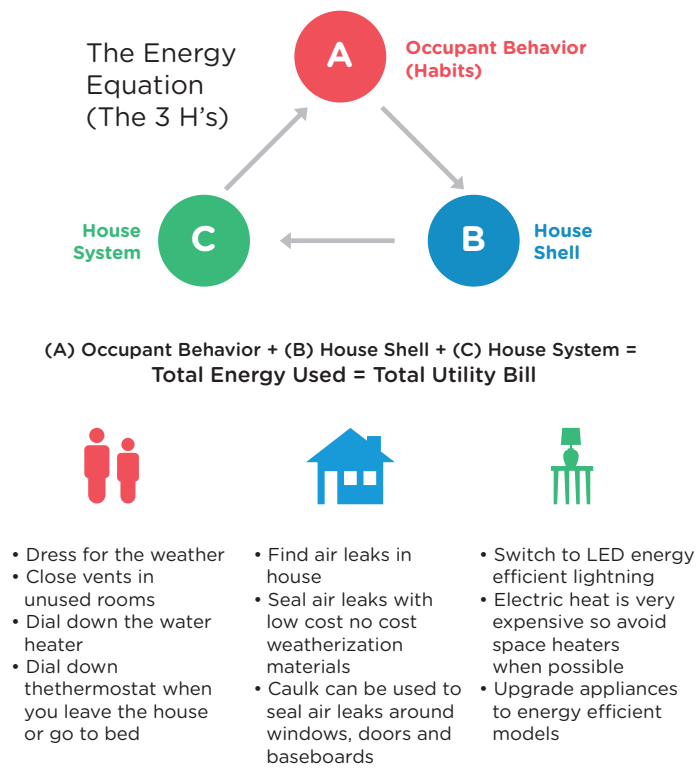


Figure 1: EcoWorks Energy Smart diagram for understanding home energy use, interactions, and the utility bill

Energy Smart

Building systems, building envelope, and occupant behavior are the keys to having a home that is comfortable, healthy, energy efficient, and safe. Figure 1 below is taken from EcoWorks' Energy Smart Curriculum and offers a view of how the above-mentioned three components can be balanced effectively to reduce your electric and gas utility bill. While large problems in your home may create additional challenges to creating an energy smart home, a household can work to change behaviors and apply simple principles throughout the home to have a positive impact on energy use during the entire year.

For example, a window kit can be applied to temporarily block drafts after caulk has been applied to seal windows. If you are interested in purchasing all-season storm window kits, additional information can be found at Tyz-All Plastic Interior Storms - cleanenergyoutlet.org and Reusable Storm Window Kit. amconservation.com

Weatherization Assistance Programs

Weatherization addresses deficiencies in the building envelope or house shell so that the "ideal building maximizes heat retention during the winter and minimizes heat gains during the summer to reduce heating and cooling needs."²

Wayne County residents interested in the Weatherization Assistance Program (WAP) for their home can contact Wayne Metropolitan Community Action Agency to sign up and qualify as a program participant. If you live outside of Wayne County, you can refer to the State Map of Weatherization Operators to find the community agencies participating in your county. Some of the services offered through this program are:

- Wall insulation
- Attic insulation
- Foundation insulation
- Air leakage reduction

² John Krigger, Chris Dorsi, Residential Energy Cost Savings and Comfort for Existing Buildings, Saturn Resource Management, Fifth Edition, 2009, available at <https://srmi.biz/>

Financing Energy Efficiency Upgrades and Solar

Solar Investment Tax Credits (ITC): The 30% federal investment tax credit (ITC) is among the most important incentives currently available for solar PV. The ITC is a tax credit that can be claimed on federal income taxes for 30% of the cost of a solar PV system. A tax credit is a dollar-for-dollar reduction in the amount of income tax you would otherwise owe. For example, claiming a \$1,000 federal tax credit reduces your federal income taxes due by \$1,000. The ITC will step down to 26% in 2020, 22% in 2020, 22% in 2021, and a permanent 10% for commercial and utility construction projects started during respective years cited.

Michigan Saves Home Energy Loan Program: Michigan Saves is a nonprofit organization that operates as a “green bank” to offer financing programs that help Michigan residents take control of their energy costs through efficiency and renewable projects. Michigan Saves has a Home Energy Loan Program with available financing up to \$40,000 over 12 years at standard rates as low 4.99% APR.

This program is eligible for energy efficiency measures, water efficiency measures, and renewable energy systems (e.g., solar PV and battery storage).

Detroit 0% Interest Home Repair Loans: This program for Detroit homeowners offers 10-year, interest-free loans (0% APR) from \$5,000 to \$25,000 to invest in and repair your home including installing a new roof and solar. Program eligibility requires that safety hazards like mold/lead/asbestos be addressed first with funds received before proceeding to electrical, roofing, door, window replacement, or exterior building repair projects.

Solar Lease/Power Purchase Agreement: If utilizing a loan or direct ownership is not a viable option, third-party ownership of solar PV may be a good alternative, as it allows homeowners to avoid upfront installation costs while spreading out the payments. The two third-party ownership arrangements are a solar lease and power purchase agreement (PPA). Under a solar lease



Single-Family Housing (Owner-Occupied)

- Grants
- Loans/Solar Loan
- Tax-Incentives Federal -30%
- Third-party Leasing/ESA
- Power Purchase Agreement (PPA)
- 0% Home Repair Loans (Detroit)

Multi-family Housing (+Federal Housing Credits)

- Grants
- Capital Refinancing
- Property Accessed Clean Energy(PACE)
- Third-party Leasing/ESA
- Power Purchase Agreement (PPA)

Low-Moderate Income (LMI) Tenant or Homeowner

- Grants
- Loans/Solar Loan
- Tax-Incentives Federal-30%
- 0% Home Repair Loans (Detroit)
- Power Purchase Agreement (PPA)

Figure 2: Options for financing different types of solar

arrangement, a homeowner or business enters into a service contract to pay scheduled, pre-determined payments to a solar installation company, which installs and owns the solar system on the homeowner's property. The homeowner consumes the electricity that the leased solar system produces. If the system provides excess electricity to the grid, the owner gets credit for that generation from DTE. The homeowner or business pays the regular utility rate for any electricity consumed beyond what the solar system generates. With a solar PPA, the owner contracts with a project developer that installs, owns, and operates a solar system on the homeowner's site and agrees to provide all of the electricity produced by the system to the homeowner at a fixed per-kilowatt-hour rate, typically competitive with the owner's electric utility rate. Both products allow a homeowner or business to benefit from solar while paying no upfront costs.

There are options available for owners that allow for the financing of a PV energy system where financing is based on an individual case and, more importantly, on the amount of your energy use you would like to offset or reduce. The options shown in Figure 2 are three of the broad categories that apply to individual homeowners or multifamily housing owner/investors interested in reducing energy footprint of properties through lower cost electricity and increased property value. The examples listed above also demonstrate where the scattered growth of solar can currently be seen across the city in variety of neighborhoods.

Resources for Energy Assistance

Currently, the State of Michigan, through the Michigan Department of Health and Human Services (MDHHS), has implemented an online system that provides all Michigan residents who register with MIBridges automatic results for any qualifying energy services. The suggested services that may be returned in your registration with DHS will include energy services such as bill assistance, weatherization, and energy efficiency assistance programs. There may be other services from smaller community service agencies that have funding sources outside of federal, state, and municipal resources.

Solar 101

The Basics

Photovoltaic, or PV, has the basic function of converting solar energy in the form of light into electrical energy. A cell is the smallest unit in a PV system where 60 or 72 cells are the two quantities produced. The process requires that the solar panels or modules capture a percentage of the light that irradiates the panel. Efficiency is the percent value that is assigned to a module that reflects the highest or “best case scenario or ideal conditions” at which the module can match the manufacturing nameplate production measured in watts (W) and amps (A) of useable energy.

Under real world conditions, this number is rarely achieved based on losses along the path; systems are sized to compensate for the calculated small losses. Ultimately, the wires, connections, inverter, temperature, and conduit for wires have all contributed a small part in reducing the actual usable energy that reaches the main electrical box. A solar installation contractor designs a system that takes into account all of these factors so that the amount of modules installed meets your particular energy production needs. A battery based system sends some of the energy produced to a storage battery where energy can later be used whenever it is needed, based on how a particular PV system is wired for a period of time when electricity is not being generated or taken from the utility grid.

Safe Solar

Solar PV technology is a clean source of energy that offers the benefits of renewable energy and is accessible to a greater number of people. As a mature technology that continues to improve as costs go down, it provides numerous positive impacts for individuals and communities while eliminating the negative health impacts of burning fossil fuels like coal and gas for electricity needs.

Low-Risk Solar PV

- Solar PV Panels:** Research by the World Health Organization (WHO) concludes that the health risks for electric fields (between 0 to 100,000 Hz) pose no substantial risk to the public. PV panels produce a direct current (DC) that is stationary (0 Hz). An operating PV panel produces an electro-magnetic field (EMF) that has no impact on a compass needle placed directly on the surface of a panel.³
- Non-Panel System Components**
 - Racking:** Vertical and horizontal post portions of the mounting structure are composed of galvanized steel or aluminum. This includes both ground-mounted systems and rooftop systems. The racking systems are made of common building materials and would have the same environmental, health, and recycling protocols of existing building materials of similar composition.

³ NC Clean Energy Technology Center, “Health and Safety Impacts of Solar Photovoltaics, May 2017.

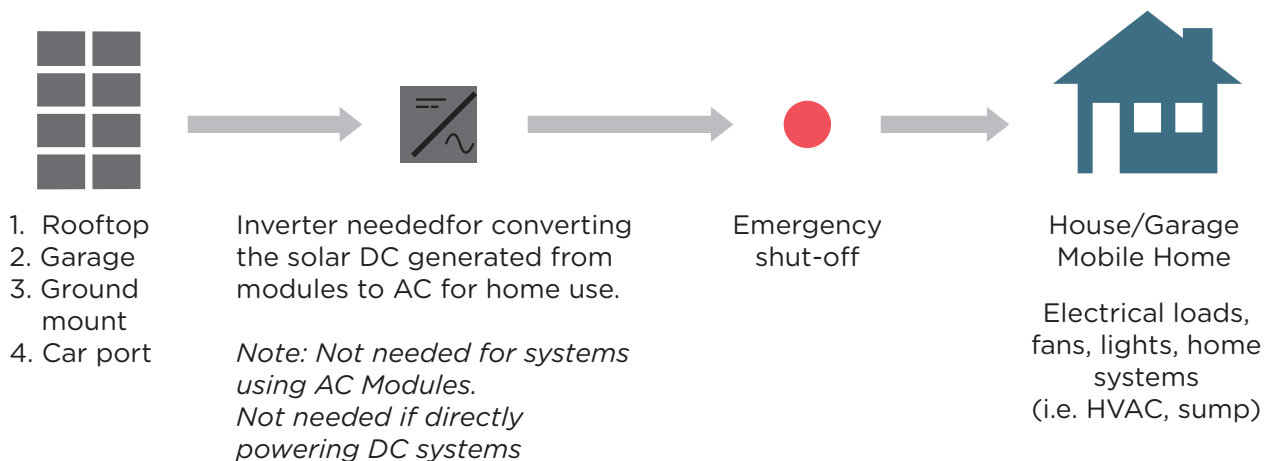


Figure 3: Basic Solar Layout

- **Electromagnetic Fields (EMF):** During the operation of a PV system, there is an EMF generation which may be commonly referred to as radiation. An electric field and a magnetic field are the two aspects that comprise the electromagnetic field. The radiation that is generated from large solar facilities is not significant to individuals walking outside of a perimeter of a facility. The radiation that solar facilities produce is not beyond the normal exposure observed for the daily lives of individuals.
3. **Electrical Shock:** There are multiple limited dangers within a residential, commercial, or utility PV system that can cause a dangerous electrical shock. The design and equipment installed for PV systems creates a safe system when industry standard protocols are followed.
 4. **Fire Hazards:** There are a small number of components in PV systems that are flammable but the primary fire hazard is associated with the heat generated from a larger intense structural fire. Fire personnel have the greatest risk with fire hazards and only if the system is “not disconnected”. There are special PV training programs to address the procedure and techniques for fire personnel to safely address a fire at a structure or site that has installed PV systems.

The safety of PV systems in the U.S. for electrical, mechanical, and fire risk is addressed in the National Electric Code (NEC), International Residential Code (IRC) coupled with the International Energy Conservation Code (IECC), and International Fire Code (IFC), respectively, with additional support in the International Solar Energy Provisions (ISEP). Local municipal codes for the City of Detroit are based on the most up to date standards and procedures that ensure the safety of residents and fire personnel.

PVC System Category Types

Category 1

- Single utility meter
- Single family, commercial
- Rooftop or ground-mounted
- Less than or equal to 20kW

Category 2

- Two utility meters (inflow and outflow)
- Multifamily, commercial, industrial
- Rooftop or ground-mounted
- 21kW up to or equal to 150kW

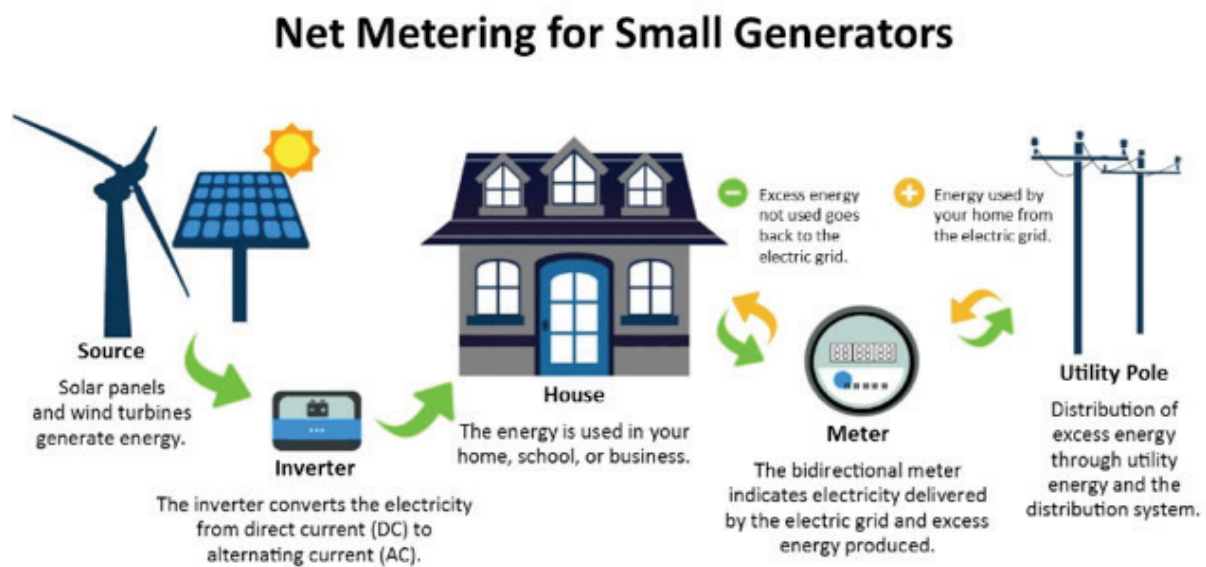


Figure 4: Current Distributed Generation “retail credit” program in Michigan¹⁷

Solar Permitting Process

Solar Permitting Process

Upon making the decision to purchase and/or have a solar PV system installed, DTE requires that you submit a formal application for customer electric generation. DTE provides information on acceptable equipment if you are purchasing it without the assistance of a contractor, as well as all other connection-related details or requirements for the installation of all the components associated with a PV system. DTE has five categories that are the currently allowable for generator interconnections. This portion of the toolkit focuses on Category 1 and Category 2, which are the categories that are applicable to all residents within Detroit who are customers within DTE territory.

Solar in Historic Districts

State law requires that a property sited in a historic district obtain permitting before any work is performed that affects the exterior appearance of any building, structure, or open spaces on the property. This would mean that installation of racking, inverters, conduit, or modules cannot proceed without approval from the Detroit Historical Development Commission (HDC) staff in the form of a certificate of appropriateness or notice to proceed.⁵ Only ordinary maintenance is considered as work not requiring a permit and solar PV installations would not qualify for this exception under Michigan law or Detroit HDC qualifying work measures.⁶ Recent resolution by the Detroit HDC has delegated authority of “minor classes of work” approval by HDC staff for solar energy systems meeting following six criteria:

1. The solar panels are installed in areas with limited-to-no visibility to the public right-of-way.
2. Ground-mounted panels shall be located in a rear yard.
3. Roof-mounted panels shall be flat-mounted and located on a rear roof elevation and/or garage, with

- adequate distance from roof edges and ridge.
4. Panels shall be a matte, dark finish consistent with the color of the existing roofing material.
5. Wall-mounted panels won't cover existing architectural features, nor damage existing wall materials.
6. The installation(s) shall comply with the National Park Service Technical Preservation Serviced document, “Incorporating Solar Panels in a Rehabilitation Project” (ITS Number 52).⁷

Any systems not meeting the above six criteria would be subject to presenting before the Detroit HDC at their monthly meeting, after completing an application in advance.

The HDC guide available on the City of Detroit Website, What You Need to Know About Local Historic Districts, has additional information related to solar energy systems and any other updated requirements. The building permit application process map can be found at the end of the brochure indicating steps of submission to HDC staff from start to final permit or certificate of appropriateness granted.

DTE Online Application

PowerClerk is the software interface to begin an interconnection agreement application. It tracks applications through the entire process for residents and commercial entities for Category 1 and Category 2, which covers most applications of solar PV for residents and business in Detroit. For additional information about other categories for utility and industrial electrical generation, refer to the DTE Interconnection Process page online for information on customer electric generation for all electric customers in DTE territory.

⁴ MPSC Renewable Energy Customer Generation Distributed Generation Program.” *MPSC - Distributed Generation (Net Metering) Program, Michigan Public Service Commission*, https://www.michigan.gov/mpsc/0,4639,7-159-16393_48212_58124---,00.html.

⁵ MCL 399.205(1); Detroit, MI., Code § 25-2-18

⁶ MCL 399.201a(p); City of Detroit Historic Commission, What You Need To Know About Local Historic Districts, Last Revised Aug. 23, 2018, available at <https://detroitmi.gov/sites/detroitmi.localhost/files/2018-05/2016%20HDC%20Brochure.pdf>

⁷ “Incorporating Solar Panels in a Rehabilitation Project.” *Interpreting The Secretary of Interior Standards for Rehabilitation*, National Park Service, U.S. Department of Interior, Technical Preservation Services, Aug. 2009, <https://www.nps.gov/tps/standards/applying-rehabilitation/its-bulletins/ITS52-SolarPanels.pdf>.

Distributed Generation Details

Requirements and guidelines exist for developers, group of individuals, or organizations that intend to install and deploy a solar PV array or generation station in the city of Detroit; all will be required to complete the steps outlined in the Detroit Solar Panel Permitting Process.

Category 1: Less than 20kW

- Single meter
- Single family home and commercial
- Rooftop or ground-mounted

Category 2: 20 to 150 kW

- Two meters
- Commercial, multifamily, and industrial
- Rooftop or ground-mounted

Category 3: 150 to 550 kW

- Two meters
- Commercial and industrial
- Rooftop or ground-mounted

Category 4: 550 to 2MW

- Independent power producer
- Utility grade greater than 2 acres
- Ground-mounted (fixed, single axis tracking or dual axis tracking)

Category 5: Greater than 2MW

- Larger utility scale
- Utility grade greater than 10 acres
- Ground-mounted (fixed, single axis tracking or dual axis tracking)

A maximum interconnection cost of \$100, which consists of the interconnection and distributed generation application fees. Utilities are not permitted to bill for any additional study fees, testing, or inspection charges.

Category 2 customers pay all interconnection costs (combined \$100 interconnection and distributed generation program application fee), distribution study fees, and any required distribution system upgrade costs.

Applicants from categories 3, 4, and 5 trigger an engineering review and circuit study from DTE.

Distributed Generation Interconnection Checklist

Start DTE Online App PowerClerk

Provide Equipment List and Specs

File Plans with BSEED for City of Detroit Permit

Site Visit Completed by DTE for Approval

Project Line Diagram

Send in Application Fee

Upload Pictures of City of Detroit Electrical inspection

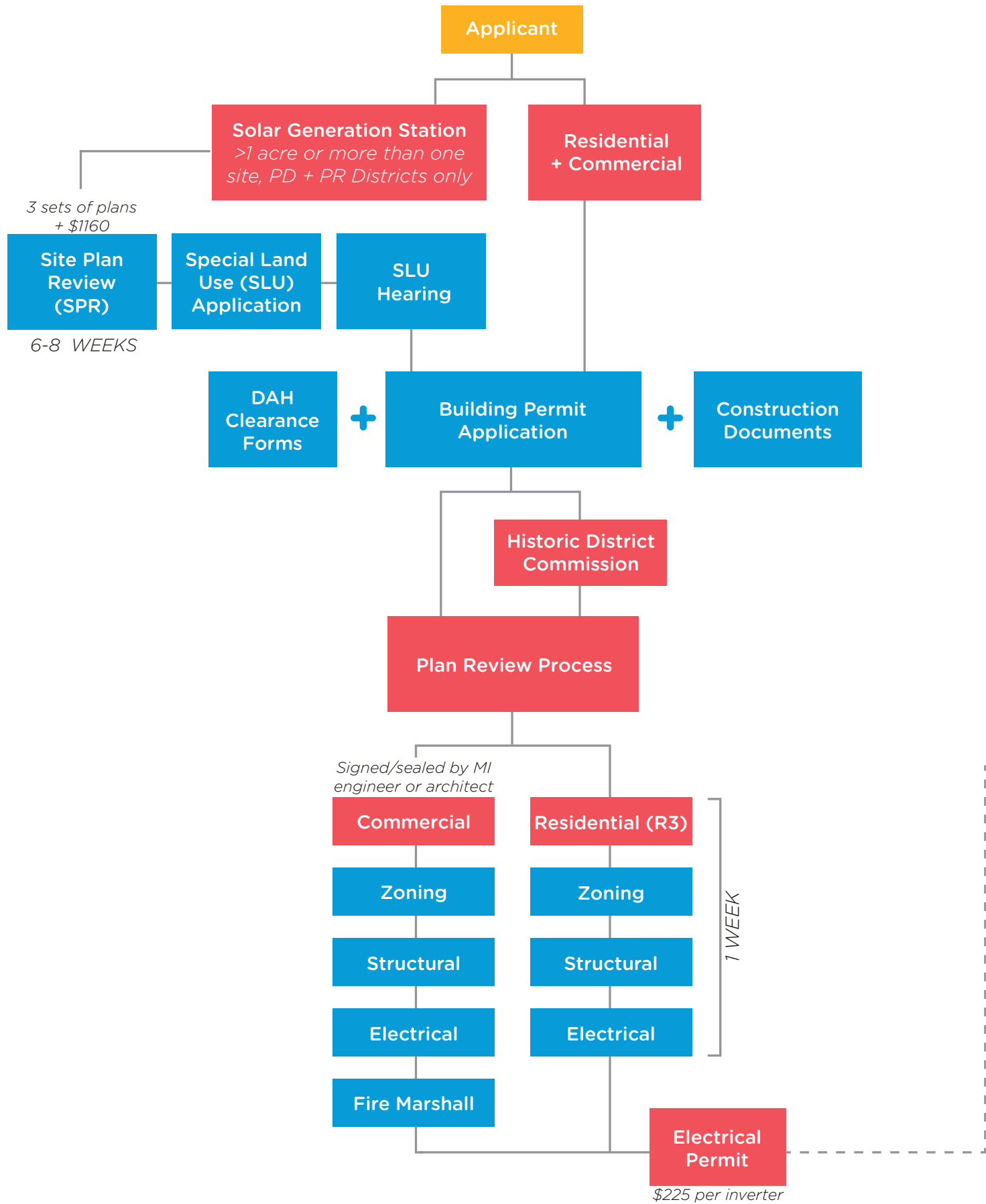
City of Detroit Solar Permitting

The Buildings, Safety Engineering & Environmental Department (BSEED) uses ePlans for building permits for completing the plan review process for the installation of PV modules. For further details, refer to the process map of the permitting process with the city.

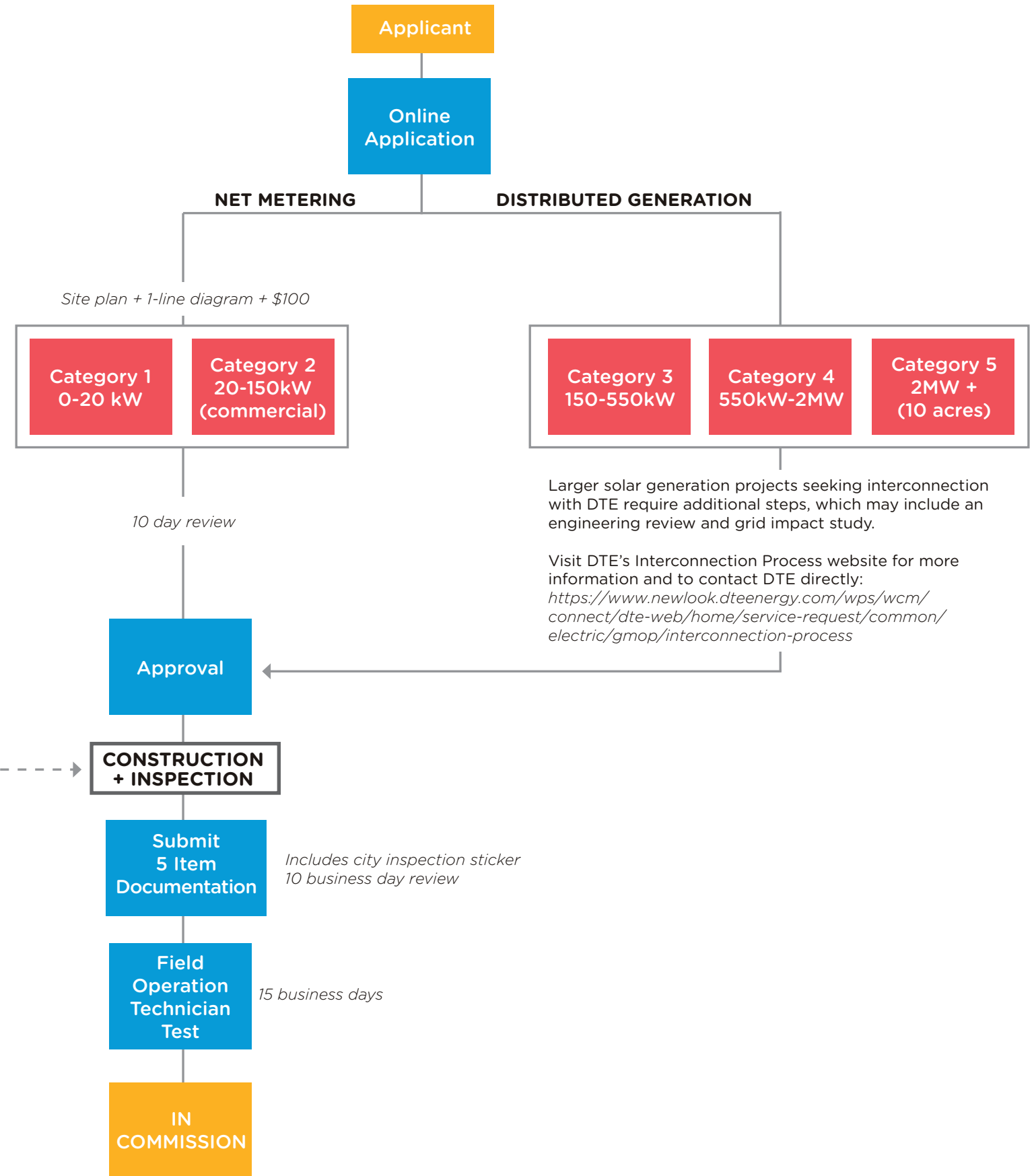
⁸ "Incorporating Solar Panels in a Rehabilitation Project." *Interpreting The Secretary of Interior Standards for Rehabilitation*, National Park Service, U.S. Department of Interior, Technical Preservation Services, Aug. 2009, <https://www.nps.gov/tps/standards/applying-rehabilitation/its-bulletins/ITS52-SolarPanels.pdf>.

Building Approval Process for Obtaining Photovoltaic (PV) Solar Panels & Solar Generation Stations - Current Process

City of Detroit



DTE



Consumer Protection

At this time, the installation of solar for your home is primarily regulated by local permits and based on electrical code regulations for structures. The Federal Trade Commission offers a guide, *Solar Power Your Home*, which provides information on the process of purchasing a solar system for your home including valuable information on incentives, bid review, lease options, and contract review.

The **Solar Energy Industries Association® (SEIA)** has created a more in-depth guide, *Installation Best Practices Guide – Residential Portfolios*, developed by the SEIA Quality Assurance Working group, which outlines consumer and solar contractor best practices for solar PV systems installed on residential properties. Further, the *PV Consumer Guide* by the National Association of Board Certified Energy Practitioners (NABCEP) provides information on where to find NABCEP certified installers in the area.

The **Michigan Public Service Commission** lists goals on its website on how the Commission seeks to achieve its mission. Among the multiple functions that it serves, the Commission acts as the state-empowered entity of

first resource for complaints against utility companies and the agency that executes the legislation in the form of public acts that shape the energy regulations for all energy utility providers. Public Act 341 and Public Act 342 determine the oversight the MPSC has over areas shown in Figure 5.

For additional information regarding energy legislation being proposed or considered, visit www.michigan.gov/mpsc and select “Energy Legislation” to see the status of the energy regulation proceedings.

PV Industry Standard Warranties

A 90% production for a minimum of 10 years and an 80% production for 25 years are standard guarantees based on specific module nameplate specifications. There are a few panel manufacturers that offer a longer and higher production guarantee of 90% production for 12 or 15 years.

Below is a modified list given in the Module 4 Starting Community-Owned Clean Energy Projects from the *Just Energy Policies & Practices Action Toolkit*⁹. This

⁹ Marcus Franklin, Katherine Taylor, Lorah Steichen, Swetha Saseedhar, Elizabeth Kennedy, NAACP Environmental and Climate Justice Program, 2017 “Just Energy Policies and Practices: Action Toolkit”, available at <http://www.naacp.org/climate-justice-resources/just-energy/>

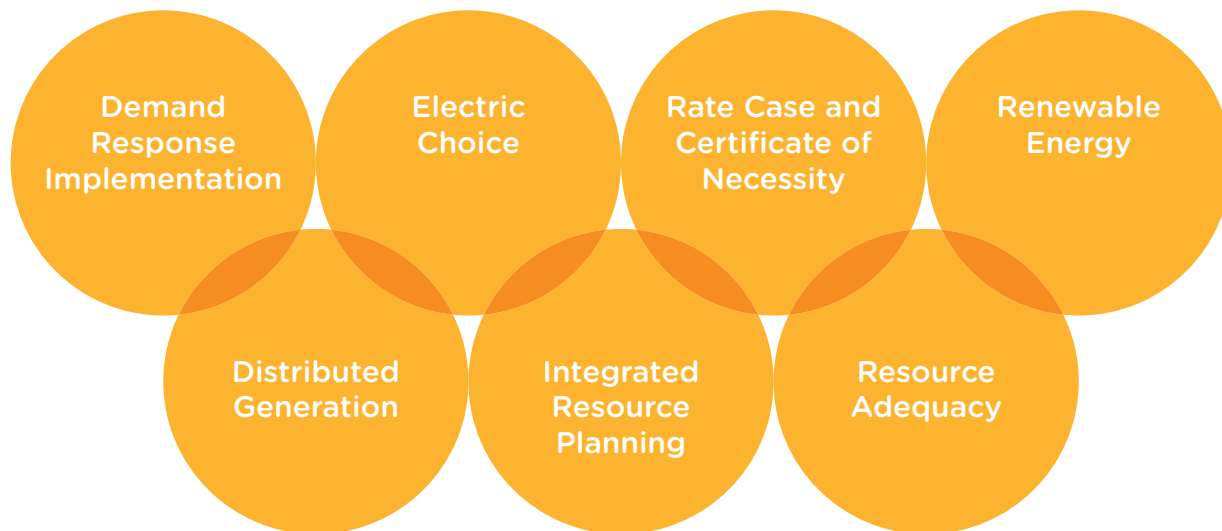


Figure 5: *The seven spheres of energy regulation that the MPSC can shape for Michigan utility customers*

list provides some examples of common solar claims from companies that use predatory or questionable sales practices.

Fraudulent Solar Claims (False Marketing and Sales Tactics)

1. “Customers should purchase systems sized to eliminate 100% of their utility bill.”
2. “It is in the customer’s best benefit to offset 100% of their expected electric use.”
3. “Leasing a solar energy system has the same benefit as owning a solar energy system.”
4. “All solar energy systems have the same 25-year warranty.”
5. “If you purchase a battery storage system, you will always have electricity even if you lose power from the utility.”
6. “You will not have any potential roof warranty issues after we install solar panels on the roof.”

Filing Consumer Complaints

The Complaint Resolution Process created by SEIA allows individuals to submit complaints with supporting documents for member contractors that have violated the SEIA Solar Business Code, which is reviewed by SEIA and Resolution Panels. Another helpful resource and consumer checklist is the Clean Energy Consumer Bill of Rights. Other resources are available from Interstate Renewable Energy Council (IREC) Consumer Protection.

Local Assistance

For questions and assistance before making a solar PV investment, EcoWorks and Great Lakes Regional Energy Association (GLREA) can help with understanding the process for your home, your nonprofit, or your business.

EcoWorks
22400 W. 7 Mile Rd.
Detroit, MI 48219
313-894-1030
ecoworksdetroit.org

Great Lakes Regional Energy Association
313-655-7945
2glrea.org

Michigan Energy Options
405 Grove St.
East Lansing, MI 48823
517-337-0422
michiganenergyoptions.org

Solar FAQs

Q. Do we get enough sunshine in Michigan for solar to work?

A. Yes, our solar daylight hours are over four hours when averaged for the entire year.

Q. Can I still obtain a permit for solar if I have blight violations?

A. No.

Q. Can I mount solar panels on my garage?

A. Yes, that would be considered under Accessory Use Zoning.

Q. Where do you go online to submit permits for the City of Detroit?

A. ePlans is name of the online submission portal. <https://detroitmi.gov/departments/buildings-safety-engineering-and-environmental-department/building-permit-information/electronic-plan-review-eplans-building-permits>

Q. How should I handle a neighbors' branches growing over my yard, shading my solar panels?

A. Michigan does not recognize any common law rights to sunlight. Therefore, you have no right to solar access unless negotiated privately or by a state or local law.

Q. Do I need a mechanical permit for installing solar panels on my roof?

A. No. But an electrical permit is one of the requirements.

Q. How far from the property line do my solar panels need to be for zoning requirements?

A. There are no special requirements for solar energy systems.

Q. All of my plans have been submitted and approved by DTE, do I still need to deal with Detroit permits?

A. Yes, this is a safety and health issue for all residents so that EMS or firefighters can approach homes with awareness of electrical hazard potential.

Q. Can I submit all of my paperwork for DTE and City of Detroit online?

A. Yes.

Q. I already installed my PV array, Should I still file an interconnection with DTE and permits to the City of Detroit?

A. Yes, if you would like any net-metering credits for solar energy you are generating beyond your daily consumption. (The current net-metering option will only be available for interconnection applications filed before rate case decision sometime after April and before June 2019. If you are not connecting through the DTE smart meter, then you would not need to file with DTE. The City of Detroit could potentially cite you with a code violation.

Q. Can I legally share my electricity with my next door neighbor?

A. No. Current Michigan law will not permit you to transport over parcel boundaries to another entity.

Q. Can I install solar panels in the empty lot that I own next to me?

A. Yes, that system would be considered an accessory use for the empty lot.

Q. I'm a developer looking to install solar on some empty lots next to different homes I own in Detroit. Do I need to get permits for each system or can I just submit one package for them all together?

A. Each house is considered a separate system so they will all require individual review but you could submit all at the same time.

Q. Will my solar PV system still work if the power goes out in my area?

A. No. Solar PV systems are set up to shut down but a "hybrid inverter system" design can operate in "island mode" and allow you to be completely removed from the grid while still feeding power to your secondary/backup electrical panel.

Q. Do I still have to pay DTE even if I only use my own solar generated electricity and none of theirs?

A. After May 2019, you will be required to pay a monthly service connection fee despite not using any electricity through the DTE meter.

Solar Glossary

This is a list of some of the common terminology that is used in describing and discussing photovoltaic systems for residential or small commercial systems. A PV installation solar contractor, advocacy group, or utility company may use some or all to explain the different aspects of the PV systems and development.

Array: Any number of photovoltaic modules connected together to provide a single electrical output. Arrays are often designed to produce significant amounts of electricity.

Behind the meter: Refers to solar installed on the property of a residence or business for the customer's own use. The electricity generation from the solar array is used on-site and reduces that customer's demand on the electricity grid.

Balance of system (BOS): Represents all components and costs other than the PV modules. It includes design costs, land, site preparation, system installation, support structures, power conditioning, operation and maintenance costs, batteries, indirect storage, and related costs.

Solar battery: A device that reserves energy for later consumption that is charged by a connected solar system. The stored electricity is consumed after sundown, during energy demand peaks, or during a power outage.

Cell: The basic unit of a photovoltaic panel or battery.

Charge controller: An electronic device which regulates the voltage applied to the battery system from the PV array. It is essential for ensuring that batteries obtain maximum state of charge and longest life.

Community solar: Also known as Shared Solar or Community Shared Solar. Under a community solar model, multiple shareholders (owners) purchase one or more solar panels or kW capacity in a centralized array. These shareholders receive financial benefits (credit on their utility bills, cash payments, etc.) from the solar energy production.

Distributed systems; distributed generation (DG): Systems that are installed at or near the location where the electricity is used, as opposed to central systems that supply electricity to grids. A residential photovoltaic system is a distributed system.

Electrical grid: An integrated system of electricity distribution, usually covering a large area.

Grid-connected (PV system): A PV system in which the PV array acts like a central generating plant, supplying power to the grid.

Inverters: Devices that convert dc electricity into ac electricity (single or multiphase), either for stand-alone systems (not connected to the grid) or for utility-interactive systems.

Kilowatt (kW): 1000 watts.

Kilowatt-hour (kWh): One thousand watts acting over a period of one hour. The kWh is a unit of energy. 1 kWh=3600 kJ.

Load: Anything in an electrical circuit that, when the circuit is turned on, draws power from that circuit.

Megawatt: 1,000,000 watts.

Module: A number of PV cells connected together, sealed with an encapsulant, and having a standard size and output power; the smallest building block of the power generating part of a PV array. Also called a panel.

Peak load; peak demand: The maximum load, or usage, of electrical power occurring in a given period of time, typically one day.

Photovoltaic (PV) array: An interconnected system of PV modules that function as a single electricity-producing unit. The modules are assembled as a discrete structure, with common support or mounting. In smaller systems, an array can consist of a single module.

Photovoltaic (PV) cell: The smallest semiconductor element within a PV module to perform the immediate conversion of light into electrical energy (dc voltage and current).

Photovoltaic (PV) efficiency: The ratio of electric power produced by a cell at any instant to the power of the sunlight striking the cell. This is typically about 9% to 14% for commercially available cells.

Photovoltaic (PV) system: A complete set of components for converting sunlight into electricity by the photovoltaic process, including the array and balance of system components.

Power Purchase Agreement (PPA): A legal contract in which a developer owns and operates a solar array and customer or group of customers agree to purchase the system's electric output for a predetermined period.